

# Energy augMentation Power bEaming Safety Study (EMPRESS) Exploring Safe, Reliable Power for AAM Vehicles

National Aeronautics and  
Space Administration



## Challenge

- Electric air taxi batteries may not have sufficient capacity for flight operations
- Can microwave power beaming augment battery power during takeoff, landing, and holding operations?
- Is microwave power beaming safe to conduct to a AAM vehicle with human passengers and crew?

## Expected Impacts

- Enabling an "Energy on Demand" capability/service within the electric air taxi market to add external energy and thus greater range to missions
- Provide "energy relief & mobility" to first responders and affected area after a natural disaster (wildfire, hurricane, snowstorm)
- Power alternative or back-up in harsh or remote areas (open ocean, arctic, desert, etc.)
- Add multifunctionality to existing vertiport infrastructure
- Provide a backup system to power AAM vehicles during emergencies

## Solution

- Developed Energy Augmentation for Vehicle Electric Systems (EAVES) concept for the 2045 timeframe
- Explored 5 direct charging and 3 indirect charging concepts for charging AAM vehicles during flight
- Potential to increased AAM endurance/payload per flight while reducing the overall load and maintenance lifecycle of batteries
- Exploring how to safely and efficiently transfer energy similarly to how data is transferred today (i.e., transition from dial-up to wireless internet)
- Developing methods for resilient energy distribution and logistics for sustainable aerial mobility

## Results

- Pivoted energy augmentation concept to focus on the operational safety, power efficiency, flight scenarios, hazard containment, and mitigations necessary to enhance the power distribution flexibility and resiliency at future AAM vertiports
- 6-month power efficiency and safety study to identify the required power profile, top-level design, frequency and operational controls required to operate within the human environment
- Preparing NASA Technical Memorandum(TM) for direct and indirect charging concepts; expected release in March 2023

## Next Steps

- Sub-scale testing (indoor) to validate power efficiency, communication and safety controls
  - 25% power/ "Rectenna on a stick" test campaign
  - 50% power/ "Fuselage Faraday & Human Exposure" test campaign
- EMPRESS Final Report and Publication, conference paper, internal NASA panels and industry days to be held for partner and public engagement

## Participants

- NASA Ames Research Center, NASA Glenn Research Center, NASA Langley Research Center

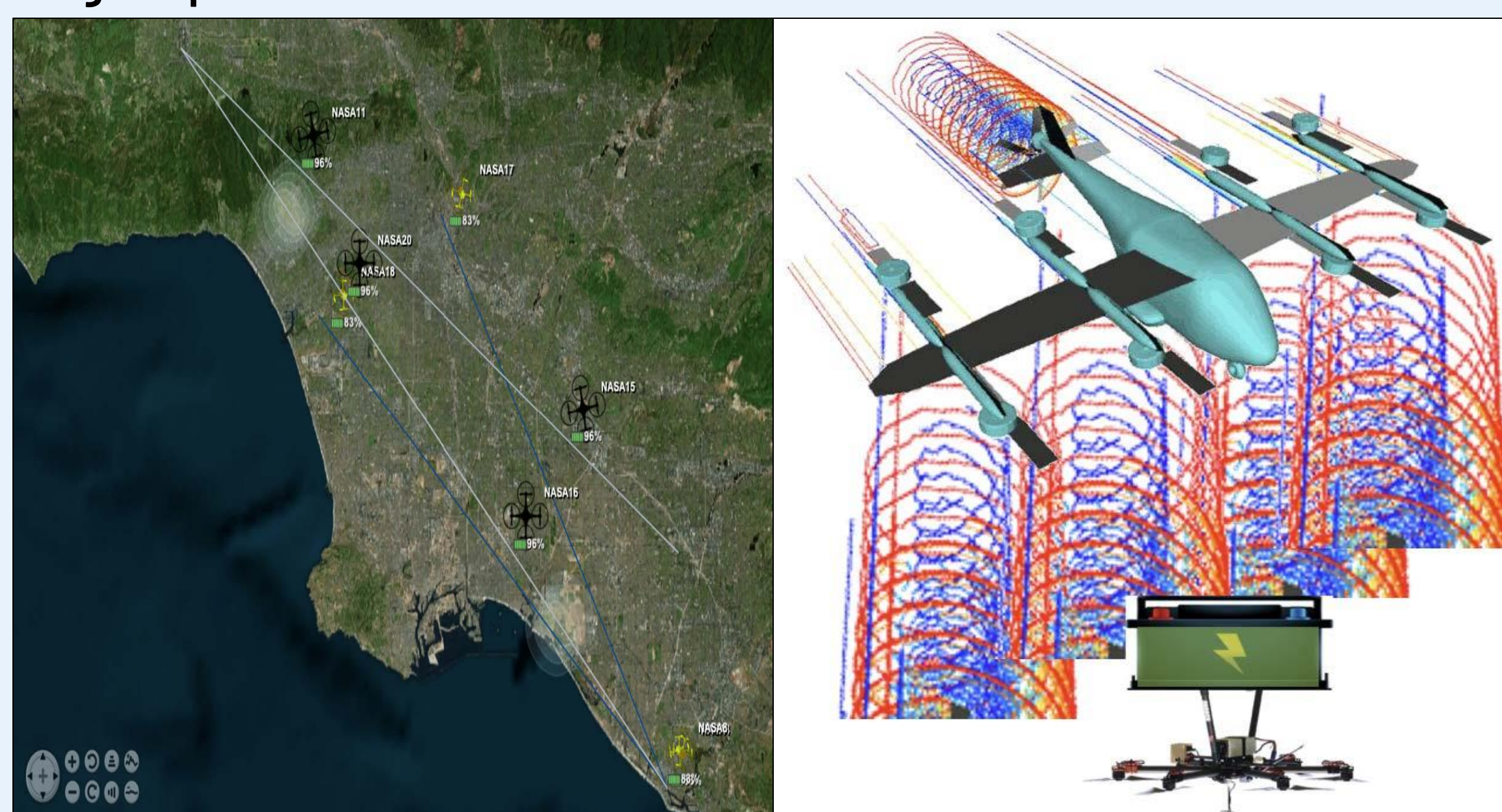
**POC:** Seth Schisler, NASA Ames Research Center



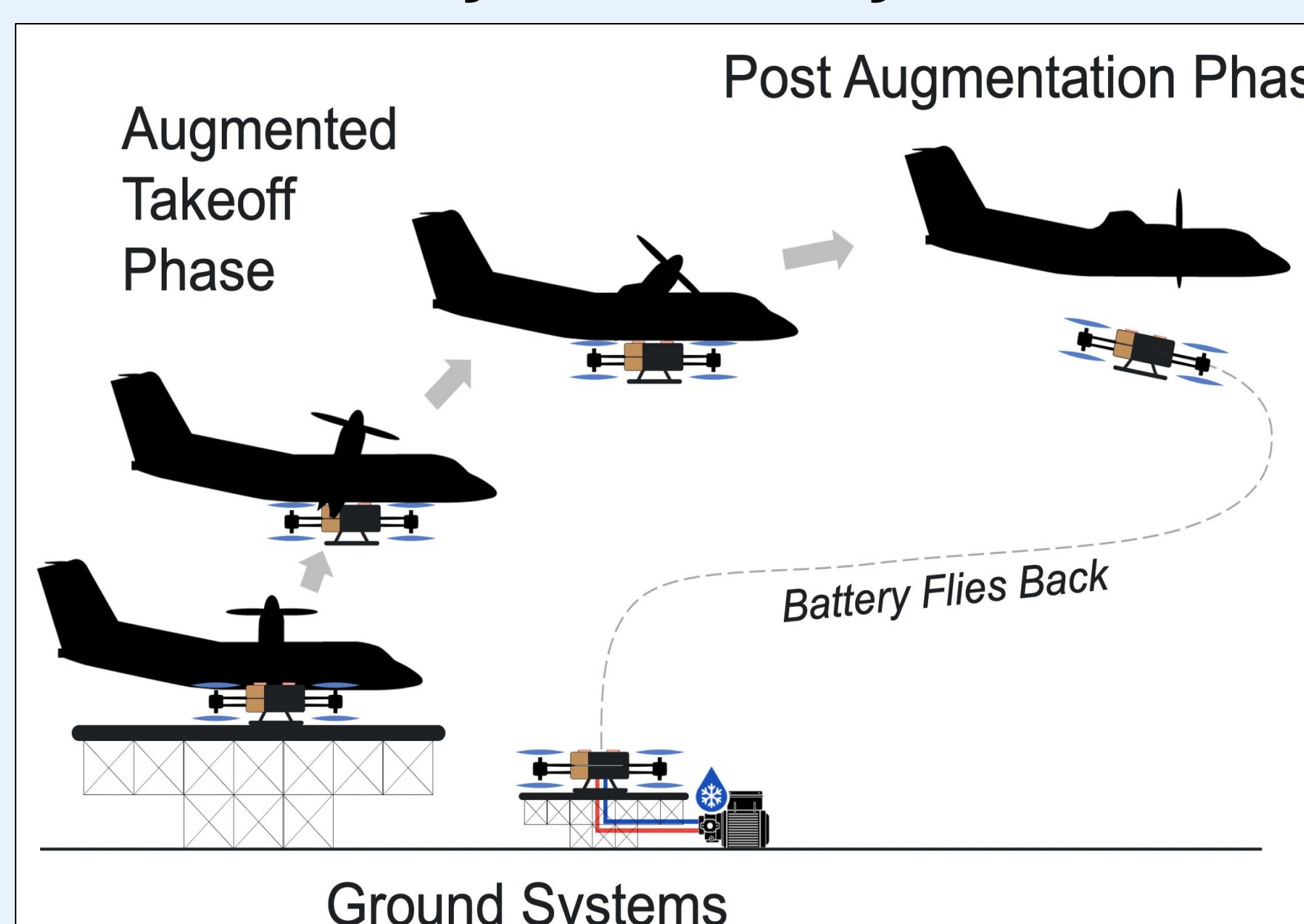
EMPRESS Concept of augmenting energy during AAM hover flight operations



Representative 6-passenger test article planned for sub-scaled testing (ex. RVL T Swing Test article )



Airspace Complexity & AAM Vehicle Flight Dynamics



"E-JATO" Concept Exploration

IMAGINAVIATION

